

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Washington Headquarters Services, Directorate for Management Operations and Policy, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4202, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20585.

1. AGENCY USE ONLY (Leave blank)			2. REPORT DATE  25 Nov 97		3. REPORT TYPE AND DATES COVERED  Interim 1 Feb 97 - 31 Jan 98	
4. TITLE AND SUBTITLE  Kuiper Belt Objects Along the Pluto-Express Path			5. FUNDING NUMBERS  NASA Grant NAG 5-4249			
6. AUTHORS  David C. Jewitt						
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  University of Hawaii Institute for Astronomy 2680 Woodlawn Drive Honolulu, HI 96822			8. PERFORMING ORGANIZATION REPORT NUMBER  6-54629			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)  NASA Goddard Space Flight Center Greenbelt, MD 20771			10. SPONSORING/MONITORING AGENCY REPORT NUMBER  NAG 5-4249			
11. SUPPLEMENTARY NOTES						
12a. DISTRIBUTION/AVAILABILITY STATEMENT  <b>DISTRIBUTION STATEMENT A</b>  Approved for public release Distribution Unlimited				12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words)  The science objective of this work is to identify objects in the Kuiper Belt which will, in the 5 years following Pluto encounter, be close to the flight path of NASA's Pluto Express. Our hope is that we will find a Kuiper Belt object or objects close enough that a spacecraft flyby will be possible. If we find a suitable object, the science yield of Pluto Express will be substantially enhanced. The density of objects in the Kuiper Belt is such that we are reasonably likely to find an object close enough to the flight path that on-board gas thrusters can effect a close encounter.						
DTIC QUALITY INSPECTED 2						
14. SUBJECT TERMS  Kuiper Belt Objects, Pluto-Express				15. NUMBER OF PAGES  4		
				16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT		18. SECURITY CLASSIFICATION OF THIS PAGE		19. SECURITY CLASSIFICATION OF ABSTRACT		20. LIMITATION OF ABSTRACT



# University of Hawai'i at Mānoa

Institute for Astronomy  
2680 Woodlawn Drive • Honolulu, Hawai'i 96822

25 November 1997

Dr. Jay Bergstrahl  
Code SR  
NASA Headquarters  
300 E Street, SW  
Washington, DC 20546

SUBJECT: Progress Report, Grant NAG 5-4249

Dear Dr. Bergstrahl,

Enclosed is the annual progress report for the above referenced grant entitled, "Kuiper Belt Objects Along the Pluto-Express Path," under the direction of Dr. David C. Jewitt, Principal Investigator. This report covers the period 1 February 97 - 31 January 98, which is the second year of a three year award.

We herewith request that the additional recommended third year funding be obligated and released to the University of Hawaii. Attached is a budget for the third year.

If you have any questions, please contact Chris Kaukali, Administrative Officer, at 808-956-7562 or email, kaukali@uhifa.ifa.hawaii.edu.

Please ensure that all correspondence to this request is directed to Mr. Marvin S. Enokawa, Director, Office of Research Services, 2530 Dole Street, Sakamaki Hall D-200, Honolulu, Hawaii, 96822.

Sincerely,

A handwritten signature in black ink that reads "Gareth Wynn-Williams".

Gareth Wynn-Williams for  
David C. Jewitt  
Principal Investigator

ENDORSEMENT:

A handwritten signature in black ink that reads "Marvin S. Enokawa".

Marvin S. Enokawa  
Director  
Office of Research Services

DCJ:ck

xc: Theresa Curtis, 216.0  
NASA CASI  
ONR  
✓ DTIC  
UH ORS  
David Jewitt, IfA

19971208 049

Progress Report: **KUIPER BELT OBJECTS ALONG THE PLUTO-EXPRESS PATH**

Principal Investigator: David Jewitt  
Institute for Astronomy, University of Hawaii  
2680 Woodlawn Drive  
Honolulu, HI 96822

Grant: NAG5-4249 (formerly NAGW-4918 from HQ)

Year 2: 2/1/97 - 1/31/98

NASA Tech Officer: Jay Bergstrahl

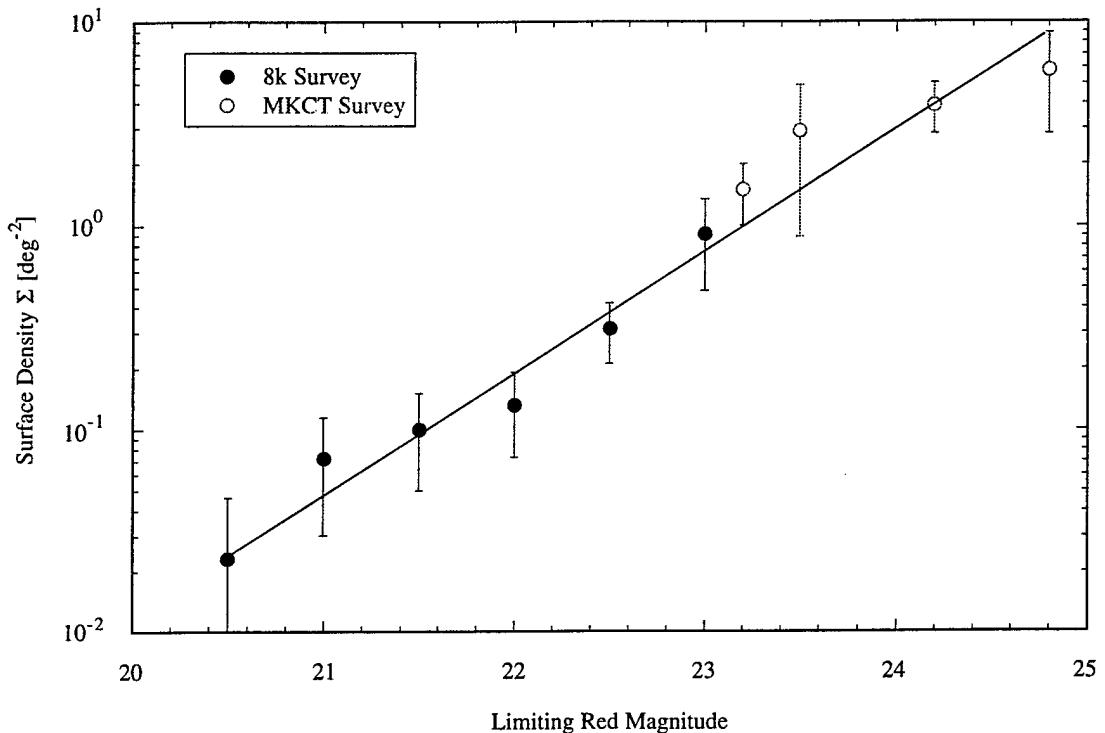
### **Goals**

The science objective of this work is to identify objects in the Kuiper Belt which will, in the 5 years following Pluto encounter, be close to the flight path of NASA's Pluto Express. Our hope is that we will find a Kuiper Belt object or objects close enough that a spacecraft flyby will be possible. If we find a suitable object, the science yield of Pluto Express will be substantially enhanced. The density of objects in the Kuiper Belt is such that we are reasonably likely to find an object close enough to the flight path that on-board gas thrusters can effect a close encounter.

### **Progress and Accomplishments**

Our work to-date has been based on the University of Hawaii 8192 x 8192 pixel charge coupled device mosaic camera. We (PI and graduate student Chadwick Trujillo) have developed a scheme by which to operate this camera in survey mode while analysing the prodigious data stream in near real-time. The camera and the method have been used at the University of Hawaii 2.2 m telescope on 4 occasions so far, resulting in the detection of 17 new Kuiper Belt Objects. Unfortunately, none of the 17 have been shown to possess orbits that will bring them close enough to the Pluto-Express post-encounter trajectory. The first phase of this work has been written up for publication (see Fig. 1, also Trujillo and Jewitt 1997). In the second year of this grant, we have started to prepare for an even larger and

more efficient survey camera. The 12k x 8k CCD camera under construction at the Institute for Astronomy will be used at the prime focus of the 3.6-m diameter CFHT, starting in March 1998. It will bring a factor of 4 to 6 improvement in survey efficiency when compared to the



*Figure 1: Surface density in the Kuiper Belt determined with the 8k CCD. The surface density is the basic parameter used to assess the likelihood of a close encounter with the Pluto Express spacecraft.*

use of the 8k CCD on the 2.2-m telescope. This improvement comes at the price of an increased data-rate. We are currently developing the software and observing strategy needed to handle 30 to 50 Gbyte per night. Observing time on the CFHT has been secured in order to use this new, improved camera in the search for Express candidates.

### Anticipated Results

A search with the CFHT and 12x8k camera is planned for May 1998. We anticipate being

able to survey 100 sq. degrees around the Pluto Express path to magnitude 23.5. We expect that either we will locate suitable rendezvous candidates, or we will show that such objects do not exist, at least at size scales  $\sim$  100 km. The Kuiper Belt objects we accumulate as by-products of the search will add to our growing knowledge of the trans-Neptunian population.

### **Relevant Publications**

Trujillo, C., and Jewitt, D. (1997). *Astronomical Journal*, in press.